MURRAY'S SCHOOL LIBRARY

WOODWORK FOR SCHOOLS

WOODWORK FOR SCHOOLS.

ON SCIENTIFIC LINES

A COURSE FOR CLASS WORK OR PRIVATE STUDY

BY JAMES THOMAS BAILY

HEAD MASTER, ST. ALBANS TECHNICAL SCHOOL; AND MANUAL TRAINING STAFF INSTRUCTOR, HERTFORDSHIRE COUNTY COUNCIL

AND

S. POLLITT, B.Sc.

HEAD MASTER, SOUTHALL COUNTY SCHOOL, MIDDLESEX

IN THREE PARTS

PART I.

LONDON

JOHN MURRAY, ALBEMARLE STREET, W.

1909

WOODWORK FOR SCHOOLS
ON SCIENTIFIC LINES

By J. T. BAILY and S. POLLITT, B.Sc.

PART I., 9d.; PART II., 9d.; PART III., 9d.
COMPLETE IN ONE VOLUME, 2s.

PREFACE

IT has been evident for some time that if manual training is to take its proper place among the other subjects of the school curriculum it must be taught by methods which, while giving due prominence to the practical usefulness of the subject learned, will develop the general intelligence of the pupil.

This is the aim the authors have kept steadily in view throughout the book. By linking the classroom with the laboratory and workshop they have provided the pupil with a course of manual work which will increase his stock of general information, and at the same time make it evident that the knowledge acquired is capable of producing visible results of a useful and valuable kind.

The construction of science models, which forms an important portion of this course, has been found to lead to exceptionally good and careful work, especially in the case of boys in secondary schools, who have to use the apparatus afterwards.

The pupil should keep a notebook in which to record his observations and answers to the questions. The master should make a point of examining these books every week.

It is hoped that candidates for the Examinations of the City and Guilds of London Institute, the Board of Examinations of the Educational Handwork Association, and the National Union of Teachers will find the book of great service in preparing for the Manual Training Certificates.

CONTENTS

INTRODUCTORY

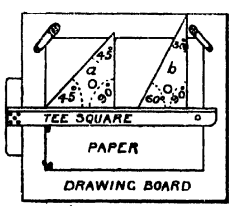
PART I

WOODWORK FOR SCHOOLS

HINTS FOR DRAWING.

FASTEN the paper on the drawing-board so that the edges of the paper are parallel to the edges of the board.

When using the tee-square keep its head in close contact with the left-hand edge of the drawing-board, using the top edge of the blade



a b SET SQUARES

FIG. 1.

as a guide to draw all horizontal lines. In projection drawing draw all perpendicular lines with the aid of the set-square, sliding it along the top edge of the tee-square blade. (See Fig. 1.)

The pencil should be chisel-pointed to draw lines (see Fig. 2), and round-pointed for lettering, figuring, sketching, etc.

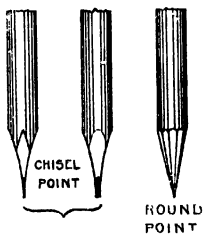


FIG. 2.

The following order should be adhered to in executing the drawings:

1. Plot out the space the drawing or set of drawings is to occupy, so that when completed it shall be symmetrical upon the paper.

2. Draw lightly the ground line, XY, when needed, and all lines necessary to the construction of the main shapes; then proceed to details.

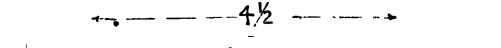
3. Line in strongly the lines representing the views of the model only, going over all circles and curves first. Show construction lines and projectors by chain lines, thus:

— — — — — · — · — — · — ·

and invisible edges of the model by short dotted lines, thus:

.....

4. Complete the drawing by neatly printing the title and the name of each view, and clearly mark all dimensions, thus:



The alphabet and figures given below may be copied, or any plain lettering used.

A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z 0 1 2 3 4 5
6 7 8 9

NOTE.—*The sizes given for the wood required for each exercise are sawn sizes—that is, a little has been allowed for planing up and squaring the ends.*

PART I

LESSON 1.

Short Straight-Edge.

Drawing.— Draw the XY line midway between the top and bottom edges of the paper; with the ruler measure off the length 10", and at each end

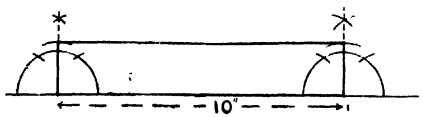


Fig. 3.

erect the perpendiculars with the aid of the compasses and ruler. (See Fig. 3.)

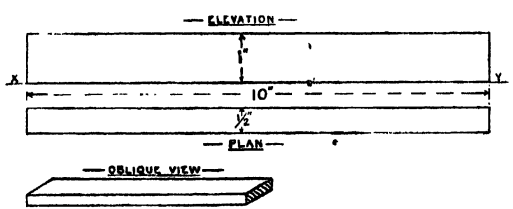


Fig. 4.

On each of these perpendiculars find a point 1" from the XY, and connect the two points. The

oblong 10″ × 1″ thus obtained is the elevation of the straight-edge.

Draw the plan of the model showing the thickness ½″ in a similar manner (Fig. 4).

The oblique view is not to be drawn.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	11″	1½″ × 1″

METHOD OF PLANING UP A PIECE OF WOOD.

(*This method must be strictly adhered to in all the following Exercises.*)

1. Plane the face side true.

2. Plane the face edge straight and square to the face side, and inscribe the face marks.

3. Gauge and plane to width. (In this case the width is 1″.)

4. Gauge and plane to thickness. (In this case the thickness is ½″.)

5. Mark off the length with try-square and marking-knife, and cut off waste ends with tenon-saw.

QUESTIONS.

1. On completing Exercise 1 measure accurately its length, width and thickness, and write these dimensions in your notebook.

2. Briefly describe the English system of measurement of length.

LESSON 1a.

Draw a square piece of wood of 10 cm. side. Prepare such a piece with the plane and saw, and cut from this two equal triangular pieces of wood. Measure length of sides and enter in your notebook.

LESSON 2.

PAIR OF WINDOW-WEDGES.

Drawing.—With the additional aid of a model,

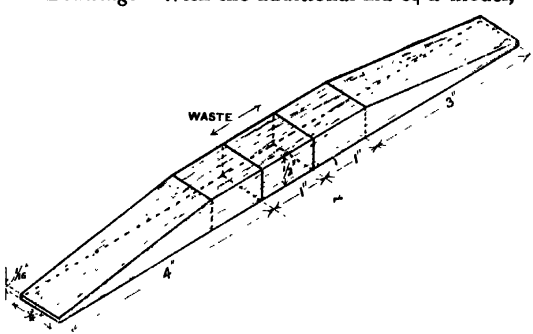


FIG. 5—PAIR OF WINDOW-WEDGES.

draw front elevation and plan, full size. Draw a freehand sketch of one wedge.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow pine ...	10″	$1\frac{1}{4}'' \times \frac{3}{4}''$

QUESTIONS.

1. Measure accurately the length and width of the chisel-pared surface of both wedges; compare the measurements with the corresponding dimensions on your drawing, and write the result in your notebook.

2. Write what you know about a lead-pencil. Give the names of each of its parts, and state if you think they are rightly named; if not, why?

LESSON 2a.

Draw a triangle on a piece of wood having two sides, each 10 cm. long. Cut this triangle out. Drop a perpendicular from the apex to base, and saw down this line.

Find what relation the parts cut bear to each other, and hence give your conclusions as to what the perpendicular has done to the base of the original triangle.

LESSON 3.

PLANT-LABEL.

Drawing.—Draw full size front and side elevations, and make a freehand sketch of the oblique view. A model of the label may be used to draw from.

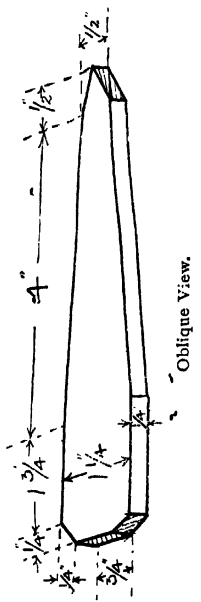


FIG. 6.—PLANT-LABEL.

STRING-HOLDER

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	8″	$1\frac{3}{4}″ \times \frac{1}{2}″$

QUESTIONS.

1. Make a freehand sketch of a jack-plane, and write against it the names of its different parts.

2. What units in the British system of measurement are used to measure superficies?

LESSON 3a.

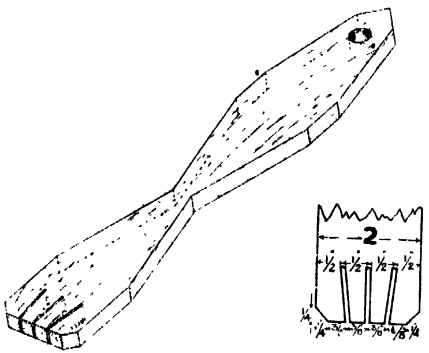
Plane all the sides and carefully square the ends of two pieces of wood to sizes of $6″ \times 1″ \times 1″$, and then let one stand on the other. Measure by aid of a protractor the angles the piece standing upright (vertically) makes with the piece lying flat (horizontally). Enter in your notebook the result obtained.

LESSON 4.

STRING-HOLDER.

Drawing.—Draw front and edge views to scale of half the full size—that is, so that 6″ shall

represent 1 foot—and draw full size sufficient of the lower end to show clearly the saw-kerfs.



Enlarged detail of lower end, showing saw-kerfs.

FIG. 7.—STRING-HOLDER.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Whitewood ...	13″	2½″ × ½″

NOTE.—Cut the saw-kerfs with the hand-saw.

QUESTIONS.

1. What is an exogen? Draw a cross section of an exogenous tree-stem, and name the different parts.

2. What was the superficial area of the piece of wood used for Lesson 4 when it was cut off to its length?

LESSON 4a.

Cut out a triangular piece of wood—length of base 7·5 cm., and two angles at the base of 45 degrees. Measure the third angle by aid of protractor, and enter this, together with the sum of all the angles, in your notebook. What useful geometrical instrument have you made, and what have you learnt about the sum of the angles of a triangle?

LESSON 5.

SMALL WALL-BRACKET.

Drawing.—A perspective view and a side elevation of the bracket are shown. Draw front elevation and plan, taking off your measurements from the dimensioned model given out to you. The side elevation shows how two supports of

Venetian strip-iron may considerably strengthen the shelf.

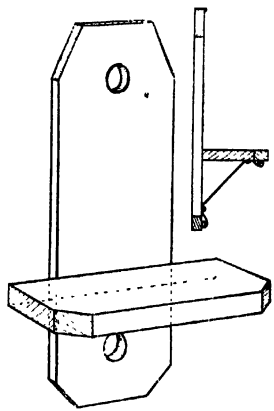


FIG. 8.—SMALL WALL-BRACKET (PERSPECTIVE VIEW)

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Yellow pine	13″	3″ × $\frac{5}{8}$″
Iron flat-headed screws	2	1″ *No. 8*
Venetian strip-iron ...	9″	$\frac{3}{8}$″ or $\frac{1}{4}$″
Round-headed screws	4	$\frac{1}{4}$″

QUESTIONS.

1. What are the chief characteristics of the class of trees known as 'Conifers'? Give a list of trees belonging to that class, and the names of any places you know in which they grow.

2. If $\frac{3}{4}$" yellow pine is sold at 3d. per superficial foot, what is the value of the piece used for Lesson 5?

LESSON 5a.

CUBE, SQUARE PRISM, AND SQUARE PYRAMID.

Drawing.—Make plans and elevations of a cube, square prism, and square pyramid.

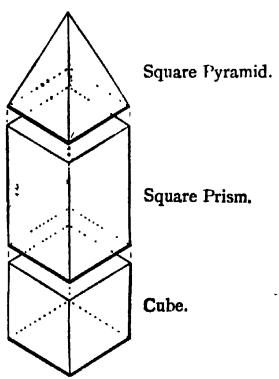


FIG. 9.—GEOMETRICAL MODELS (ISOMETRIC VIEWS).

Benchwork.—Work the three models on one piece of wood, as shown by Fig. 9.

LESSON 6.

NOTCHING EXERCISE.

Drawing.—Copy the given elevation full size, and from it project its plan. The exercise is to finish $\frac{3}{4}''$ in thickness.

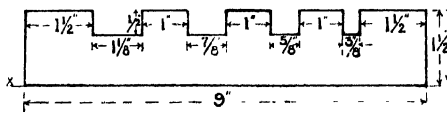


FIG. 10.—NOTCHING EXERCISE (FACE VIEW).

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	10″	$1\frac{3}{4}'' \times 1''$

Retain Lesson 6 to be used in Lesson 7.

QUESTIONS.

1. Give a short account of yellow deal and yellow pine; especially mention their appearance and chief points of difference.
2. Find out by using the scales the weight of your model (Lesson 6), giving your answer in the English system.
3. Describe the English units of weight, and those corresponding in the Metric System.

LESSON 6a.

TRIANGULAR PRISM, TRIANGULAR PYRAMID, AND TETRAHEDRON.

Drawing.—Make plans and elevations of a triangular prism, triangular pyramid, and a tetrahedron.

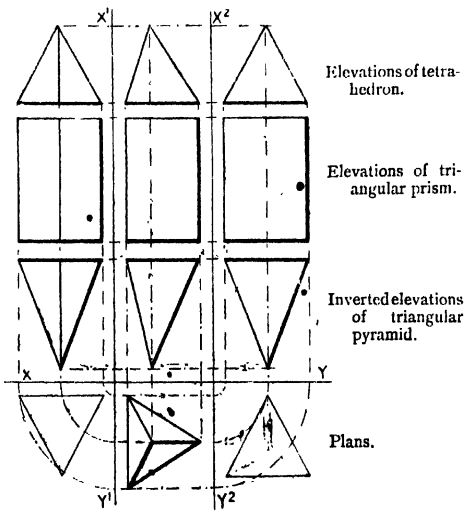


FIG. 11.—GEOMETRICAL MODELS.

Benchwork.—Work the three models on one piece of wood, as shown by Fig. 11

LESSON 7.

CHISEL-RACK.

Drawing.—A model of the chisel-rack will be given to you. Make a rough dimensioned sketch

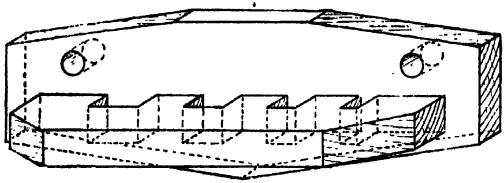


FIG. 12.—CHISEL-RACK.
View in oblique projection.

of the same, return the model to its place, and from the sketch draw a plan and elevation full size.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Exercise 6 for shelf ...	—	—
Yellow pine for back ...	11″	$3\frac{1}{2}″ \times \frac{5}{8}″$
Oval wire nails ...	5	1″

The two pieces are to be glued and nailed together.

QUESTIONS.

1. Draw a sketch of and describe the try-square.
2. What is glue? Describe how you would prepare it, and what precautions you would take in using it.

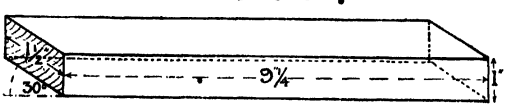
LESSON 7a.

Work two rectangular blocks of wood to size of 3″ × 3″ × 2″—one of yellow pine, the other of yellow deal—weigh them, and explain why, having equal volumes, they do not weigh the same.

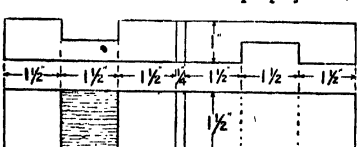
LESSON 8.

SAUCEPAN-STAND (HALVED OR NOTCHED JOINT).

Drawing.—The edge and face views are shown of the two pieces forming the saucepan-stand: draw the pieces in oblique projection, full size.



View of block of wood in oblique projection.



View in orthographic projection, showing how joint is worked.

FIG. 13.—SAUCEPAN-STAND.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	10″	$1\frac{3}{4}″ \times 1\frac{1}{4}″$

QUESTIONS.

1. Write notes about a marking gauge, illustrating the various parts by sketches.

2. What is cubic measure? Give the number of cubic inches contained in Lesson 8 when completed. How much water would it displace if floated? Give your answer in cubic inches and cubic centimetres.

3. Give four instances within your knowledge of the use of this joint in wooden structures.

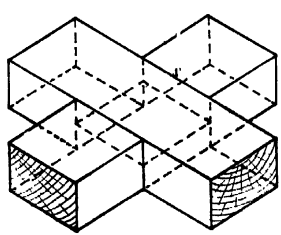


FIG. 14.—SAUCEPAN-STAND.

View in isometric projection, showing joint fixed together.

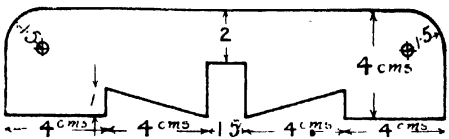
LESSON 8a.

Draw an equilateral triangle on a piece of wood having its sides 15 cm. Cut this out, and from the same piece of wood cut out a square piece of 8 cm. side. Compare their area by weighing them. Enter results in your notebook.

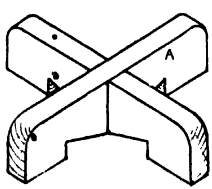
LESSON 9.

POT-STAND.

Drawing.—An isometric sketch of the pot-stand and an elevation of piece A alone are given.



Face view of piece A.



Isometric view.

FIG. 15.—POT-STAND.

Adopting metric measurements, copy the given elevation, and project its plan; then draw eleva-

tion and plan of the other piece forming the stand.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Whitewood	45 cm.	6 cm. × 2 cm.
Iron flat-headed screw	1	1″ No. 10

QUESTIONS.

1. Before commencing to work Lesson 9 measure the block of wood from which you intend to make it, and give the approximate cost of such a piece, if whitewood is sold at 5s. per cubic foot.

2. What are the chief characteristics of the class of trees known as 'leafy timber trees'? Give the names of any such trees, and the names of places you know in which they grow.

LESSON 9a.

WOODEN MEASURE, MARKED IN ENGLISH AND METRIC UNITS OF LENGTH.

Drawing.—Draw full size the equilateral triangle shown above. Assuming this view to be the end of a triangular prism 12″ long, project from the end view the true shape of two of its sides. On one

of these side views set off the English units of length, and on the other the metric units of length.

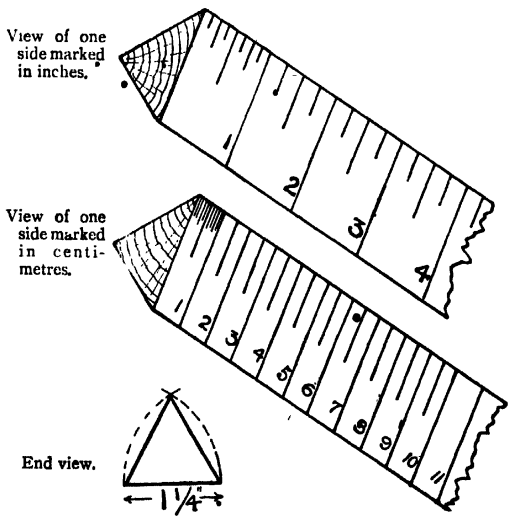


FIG. 16.—WOODEN MEASURES, MARKED IN ENGLISH AND METRIC UNITS OF LENGTH.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Beech	13"	$1\frac{3}{8}" \times 1\frac{3}{8}"$

QUESTIONS.

1. Find the area of the end of the prism, and, knowing its length, calculate its volume, expressing your result in cubic inches and cubic centimetres.

2. Find the volume of a rectangular box that would just hold the above prism.

LESSON 10.

BLIND-ROLLER OR COPPER-STICK (OCTAGONAL PRISM).

Drawing.—Draw full size an end view of the prism, which is a regular octagon of $1\frac{1}{4}''$ diameter; and project from it the side elevation. Also draw the two isometric views.

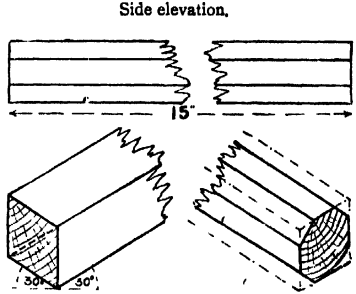


FIG. 17.—BLIND-ROLLER OR COPPER-STICK (OCTAGONAL PRISM).

The prism may be used as a washhouse copper-stick, or its length may be altered to make it suitable for a blind-roller.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
White deal ...	18″	$1\frac{1}{2}$″ × $1\frac{1}{2}$″

QUESTIONS.

1. Describe the wood used for Lesson 10.
2. Explain what you understand by the word 'isometric.' What advantage is gained by using isometric projection in preference to orthographic projection?

LESSON 10a.

VERNIER.

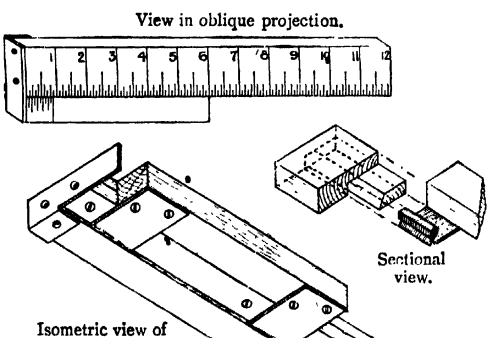


FIG. 18.—VERNIER.

Drawing.—Draw an elevation, plan, and free-hand sketches of details.

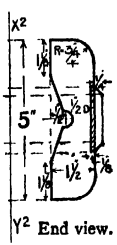
Make a list of materials required.

Any hard close-grained wood may be used; the three pieces of metal may be cut from sheet brass or copper.

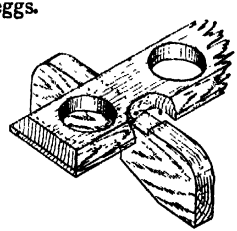
LESSON 11.

EGG-STAND.

Drawing.—Draw the end view to scale of half the full size, and from it project the plan of an egg-stand to hold six eggs.



End view.



Sketch showing connection of top to foot piece.

FIG. 19.—EGG-STAND.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Whitewood (for top)...	14″	$2\frac{1}{4}$″ × $\frac{1}{2}$″
„ (for feet)	12″	$1\frac{3}{4}$″ × $\frac{5}{8}$″
Oval wire nails ...	4	1″

The top to be glued and nailed to the feet.

QUESTIONS.

1. Write notes on American whitewood.

2. Give the meaning of the following terms used in connexion with the circle, and illustrate your answers with sketches wherever possible: radius, circumference, diameter, centre, arc, chord, segment. What multiple is the circumference of the diameter?

3. Describe the chisel you have used. What name is given to it to distinguish it from other kinds?

LESSON 11a.

TEST-TUBE STAND.

Drawing.—Prepare the necessary drawings to make the test-tube stand as illustrated (see p. 26).

Take off from your drawing the quantity of material required, and execute it in basswood.

LESSON 12.

GARDEN DIBBER (TEE-HALVED JOINT).

Drawing. — A model like the one illustrated on p. 27 is given to you, worked to metric

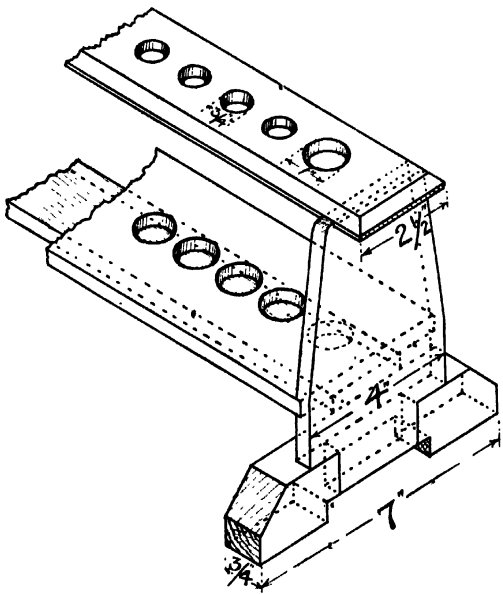


FIG. 20.—TEST-TUBE STAND.
Isometric view of one end.

dimensions. Make a freehand dimensioned sketch of the model, put it away, and from your sketch

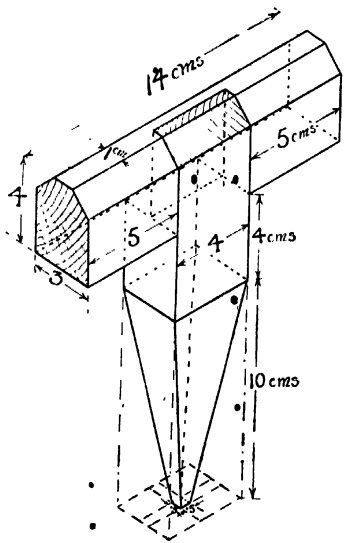


FIG. 21.— GARDEN DIBBER.

draw an elevation and plan of the complete model and an oblique view of the shorter piece, using metric measurements.

Woodwork.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	34 cms.	5 × 4 cms.

QUESTIONS.

1. Sketch and describe a tenon-saw.
2. Give any instance where you know the tee-halved joint has been used.
3. Determine the area (in square feet) of your bench top.

LESSON 12a.

Wooden Compasses.

Drawing.—Make a front elevation, a plan, and an inside elevation of one leg only.

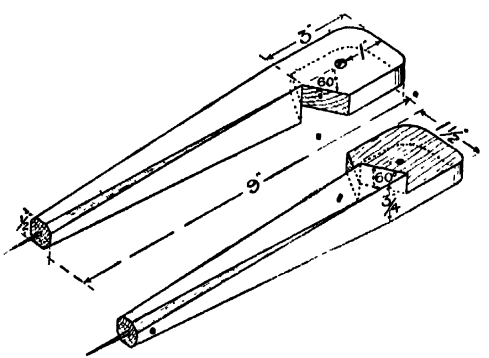


FIG. 22.—WOODEN COMPASSES.

Benchwork.—Make the model from a moderately hard wood. Strong needles may be inserted for the points, and the pivot may be either a screw or a fine bolt with wing-nut.

LESSON 13.

HAT AND COAT PEG.

Drawing.—Copy the front and side views shown, and give a plan of piece A alone.

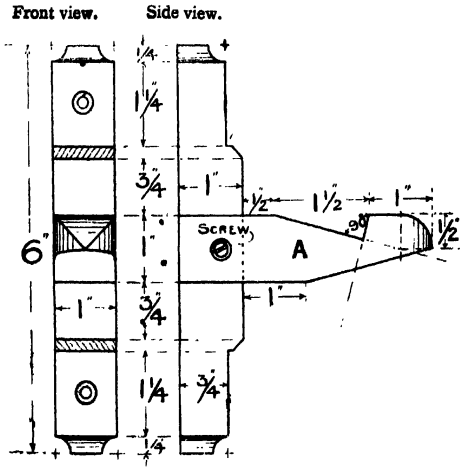


FIG. 23.—COAT-PEG.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Satin walnut	$12\frac{1}{2}''$	$1\frac{1}{8}'' \times 1\frac{1}{8}''$
Flat-headed brass screw	1	$\frac{3}{4}''$ No. 10

QUESTIONS.

1. Write notes on the wood used for Lesson 13.
2. Make a note of what you surmise the weight of the coat-hook to be. Verify by using the scales, and state what the cost would be to send it to Exeter by parcel post.
3. Sketch the hammer you use. Explain how it is one form of lever. What is the mechanical advantage derived from its use over that of a stone or piece of wood?
4. Name the materials of which the hammer is made, and explain why such materials are used.

LESSON 13a.

MODEL TO ILLUSTRATE THE PRINCIPLE OF MOMENTS.

The wheel is provided with series of holes, each series being at equal distances from the centre.

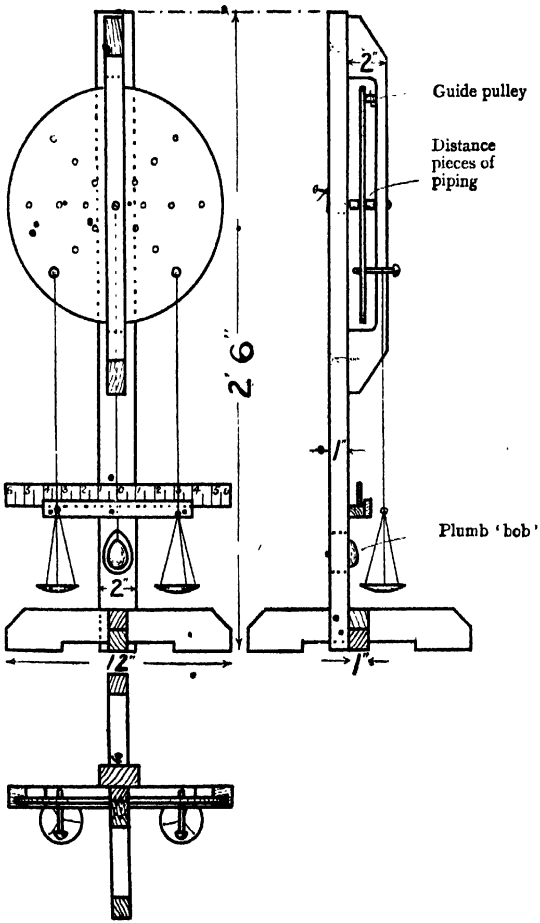


FIG. 24.—MOMENTS APPARATUS.

Two movable pegs, from which are suspended two pans, can be so arranged as to illustrate the relation of weights and distances and turning power (or moments).

Drawing.—Draw two elevations and a plan as working drawings, make out a list of materials required, and make the model.

LESSON 14.

NAIL-BOX.

Drawing.—Draw to scale of 6″ to 1 foot plan and end elevation of such a nail-box as that

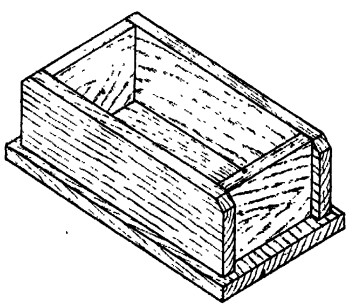


FIG. 25.—NAIL-BOX.
Isometric view.

shown in the isometric view, taking your measurements from the model supplied to you.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
White deal	2′	$2\frac{1}{4}'' \times \frac{5}{8}''$
„ „	10″	$5'' \times \frac{5}{8}''$
Oval wire nails ...	2 dozen	$1\frac{1}{4}''$

QUESTIONS.

1. Sketch and describe the different kinds of nails with which you are familiar. What is rust, and how can nails be prevented from rusting?

2. Describe the pincers. Show by a sketch how you would extract a nail with their aid, but with the least exertion on your part.

3. Show that pincers behave as a compound lever, and explain which are the fulcrum, the weight, and the power when they are in use. Give other examples of compound levers.

4. A pound of $1\frac{1}{4}''$ oval wire nails costs 3d. What would the nails cost in making a score of such boxes as in Lesson 14?

5. Give the cubical capacity of the box you have made. What would it cost to line it with lead at 5d. per square foot?

LESSON 14a.

MODEL TO ILLUSTRATE THE RELATIVE POSITIONS OF POWER, WEIGHT, AND FULCRUM IN THE THREE KINDS OF LEVERS.

Drawing.—Prepare the necessary working drawings and list of materials required before making the model.

The pulley is of the kind used for Venetian

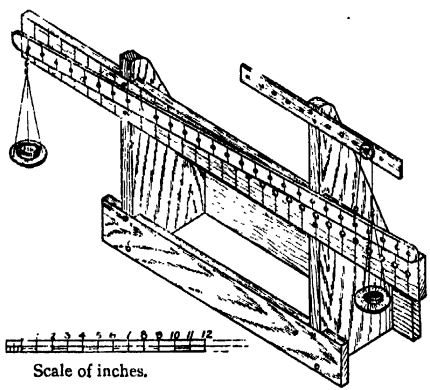


FIG. 26.—LEVER APPARATUS.
View in isometric projection.

blinds, a large picture nail acts as fulcrum, and the pans may be made from canister lids such as are used for boot polishes. The two long bars have holes pierced 1″ centre to centre for the picture-nail to enter.

LESSON 15.

WATCH-STAND.

Drawing.—Draw full size the two views as shown.

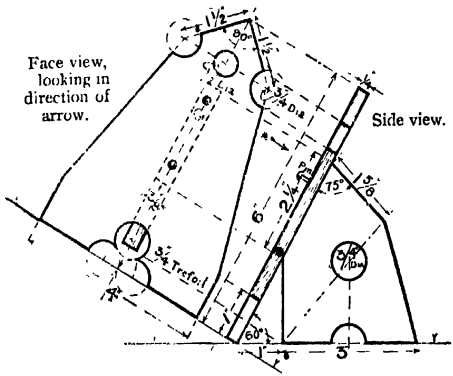


FIG. 27.—WATCH-STAND.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Virginian red cedar ...	7″	$4\frac{1}{2}$″ × $\frac{3}{8}$″
,, ,, ...	5″	$3\frac{1}{4}$″ × $\frac{1}{2}$″
Iron flat-headed screws	2	$\frac{3}{4}$″ No. 6
Brass escutcheon pin	1	1″ or $\frac{3}{4}$″

QUESTIONS.

1. Write notes on Virginian red cedar.

2. Pack the watch-stand in a parcel, direct it to an imaginary person in Paris, and find the cost of postage in English and French money. What is the value of one franc in English money?

LESSON 15a.

MODEL OF STEELYARD.

A simple piece of apparatus illustrating principle and use of the steelyard.

The arm is a piece of thin pearwood, pivoted to

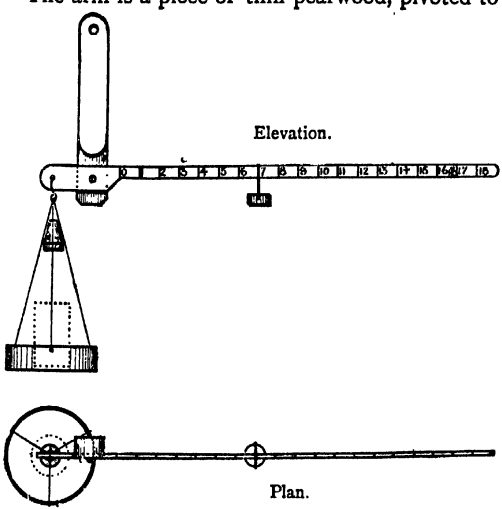


FIG. 28.—STEELYARD.

another piece of wood by means of a round-headed screw, which acts as the fulcrum; the pan suspended from the shorter arm is a canister lid, which contains the body the weight of which is to be found; a piece of lead is suspended above the pan to keep the lever in equilibrium; the constant weight suspended from the long arm is a piece of lead with a wire loop, which can be moved along the graduated arm.

LESSON 16.

TOOTH-BRUSH RACK.

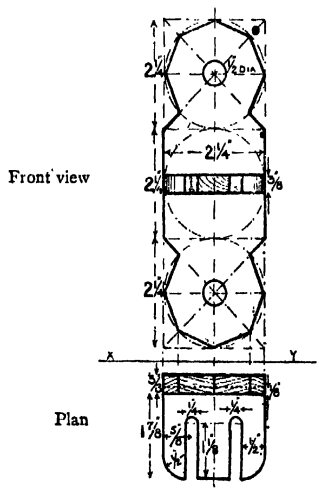


FIG. 29.—TOOTH-BRUSH RACK.

Drawing.—Draw full size the views shown, and add a side elevation. The top and bottom in the front elevation are parts of regular octagons. The shelf is housed into the back $\frac{1}{8}''$.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Mahogany	10″	$2\frac{1}{2}'' \times \frac{1}{2}''$
Iron flat-headed screws	2	$\frac{5}{8}''$ or $\frac{3}{4}''$ No. 6

QUESTIONS.

1. Sketch any screws with which you are familiar, and say what you know about them.
2. What are polygons? Illustrate your answer by sketches of different kinds of polygons.
3. Measure the angles of the polygon made, and prove by geometry that your result is correct.
4. Give notes on mahogany, and mention a few useful pieces of furniture made of this wood.

LESSON 16a.

A SIMPLE BALANCE.

The construction is such that the principles involved in the use of a balance can be easily

demonstrated. The pans can be replaced by simple pill-boxes.

Drawing.—Give a view of the balance in isometric projection, and a freehand sketch of the joint used to unite the base and pillar.

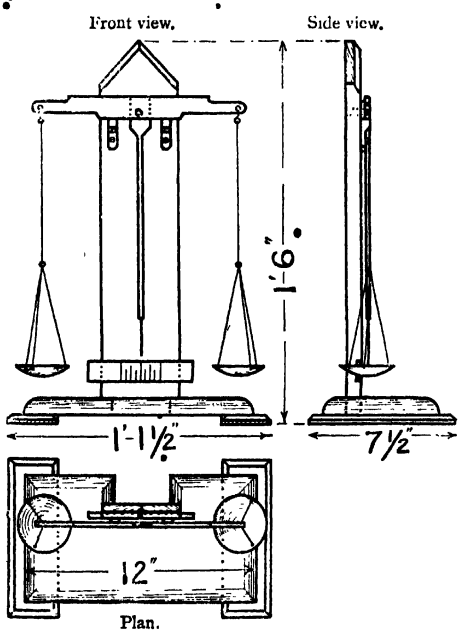


FIG. 30.—SIMPLE BALANCE.

The pivot is a piece of three-corner file, encircled by a piece of brass tubing in the beam only.

Woodwork.—Work the balance in mahogany and basswood.

LESSON 17.

WALL-BRACKET.

Drawing.—An isometric view is shown of a plain model of the bracket.

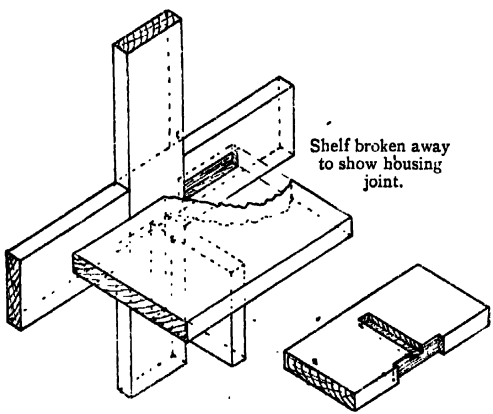


FIG. 31.—WALL-BRACKET.
Isometric view of plain model.

A model will be lent to you, from which you are required to make rough freehand dimensioned

sketches of such views as you consider will be necessary for working drawings. The bracket must not exceed the following dimensions:

Height	15″.
Width	15″.
Depth from back to front edge of shelf	8″.
Thickness of material	½″.

From your rough sketches prepare correct working drawings, altering the form to be pleasing to the eye without interfering with the principles of construction.

Woodwork.

Prepare a list of material required, and make the bracket in satin walnut.

Questions.

1. If twenty boys are to make brackets similar to yours, state how much timber will be required, and its probable cost at the rate of 3½d. per foot super.

2. Explain the following terms in connexion with timber: 'knots,' 'sapwood,' 'shakes,' 'waney edge,' 'warping,' 'medullary rays.'

LESSON 17a.

A Barometer.

The model consists of an upright piece of board, housed into a hexagonal base, with an angle block glued at the back.

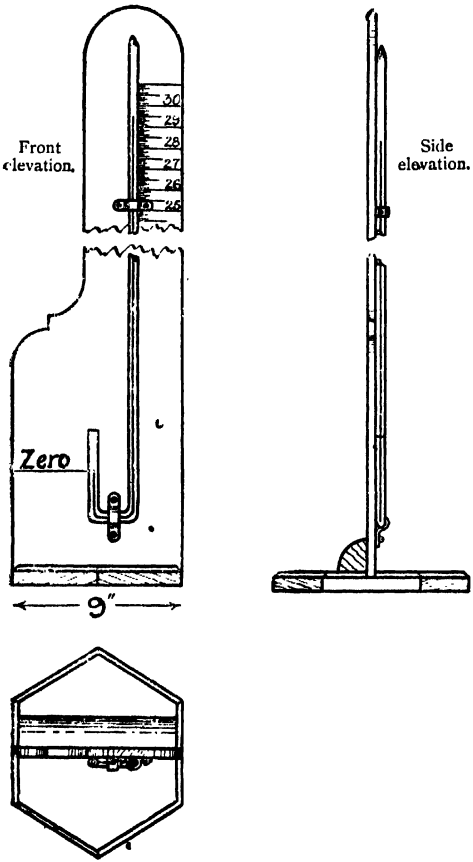


FIG. 32.—A BAROMETER.

Drawing.—Draw plan and elevation of the stand.

Woodwork.—Work the stand as shown by your drawing.

LESSON 18.

MARBLE-BOARD.

Construct a scale of two-thirds (that is, 8″ to represent 12″) at the bottom of your paper. Using

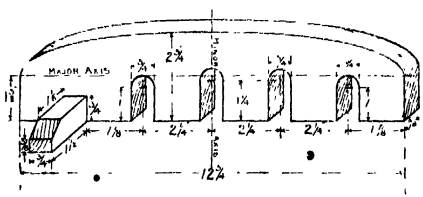


FIG. 33.—MARBLE-BOARD.
View in oblique projection.

this scale, draw an elevation and plan. The top of the board is semi-elliptical in shape. Make an isometric view of the foot-piece.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Sizes.
Kauri pine	13″	$3\frac{1}{2}$″ × $\frac{3}{4}$″
,, ,, ...	5″	$\frac{7}{8}$″ × $\frac{7}{8}$″
Oval wire nails ...	2	$1\frac{1}{4}$″

QUESTIONS.

1. Describe the kauri pine.
2. Give sketches of and notes on the brace and bits.
3. State any mechanical advantage gained when using the brace and bit.
4. Draw an ellipse, and find its area.

LESSON 18a.

BRIDGE FOR SPECIFIC GRAVITY EXPERIMENTS, TO BE USED IN CONJUNCTION WITH THE BALANCE.

Drawing.—A plan and end view are shown. Give a view in some form of conventional perspective,

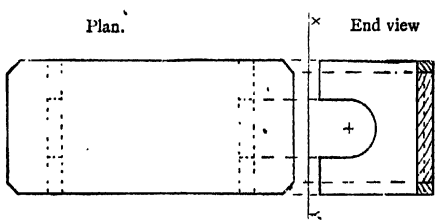


FIG. 34.—BRIDGE FOR SPECIFIC GRAVITY EXPERIMENTS.

the sizes to be suitable to the balance to be used.

Woodwork.—Execute in any suitable wood.

LESSON 19.

BENCH-HOOK.

Drawing.—Convert the given oblique view into an isometric view. Scale, 6 inches to 1 foot.

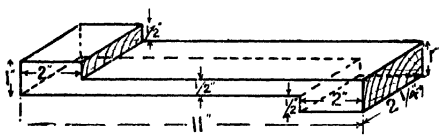


FIG. 35.—BENCH-HOOK.
View in oblique projection.

WOODWORK.

MATERIAL REQUIRED.

Description.	Quantity.	Size.
Yellow deal ...	12″	$2\frac{1}{2}$″ × $1\frac{3}{4}$″

QUESTIONS.

1. Make a sketch and write a brief description of a handsaw. What is the 'set'?

2. In what position would you place the cutting edge of the bradawl when commencing to bore a hole, and what becomes of the wood displaced by the bradawl?

LESSON 19a.

A Stand for Pulleys.

The top rests are provided with simple picture-hooks to carry the sheaves, and these blocks can be moved along horizontally.

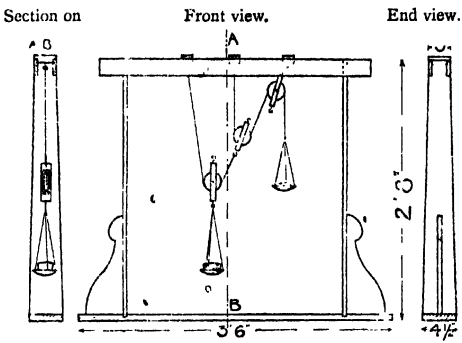


Fig. 36.—A Stand for Pulleys.

LESSON 20.

Original Model.

Drawing.—Prepare working drawings of a model of your own design, embodying tool operations similar to those you have practised in the previous lessons. State the kind of material in which you propose to execute the design, and write a list showing the sizes required.

Woodwork.—On the drawing being approved, work the model.

QUESTIONS.

1. Give a general description of your design and model, and state from the experience gained while making it what improvements you would suggest.

LESSON 20a.

ORIGINAL SCIENTIFIC MODEL.

Prepare working drawings of and make an original scientific model, which may be in the form of a toy, useful article, or simple apparatus, utilizing some scientific principle, such as the lever.

BILLING AND SONS, LTD., PRINTERS, GUILDFORD